

APPENDIX A DEFINITIONS

BEST TRACK - A subjectively smoothed path, versus a precise and very erratic fix-to-fix path, used to represent tropical cyclone movement, and based on an assessment of all available data.

BINARY INTERACTION - A mutual cyclonic orbit of two tropical cyclones around their centroid. Lander and Holland (1993) showed that the behavior of most binary tropical cyclones consists of an approach, sudden capture, then a period of steady cyclonic orbit followed by a sudden escape or (less frequently) a merger (see Figure A-1).

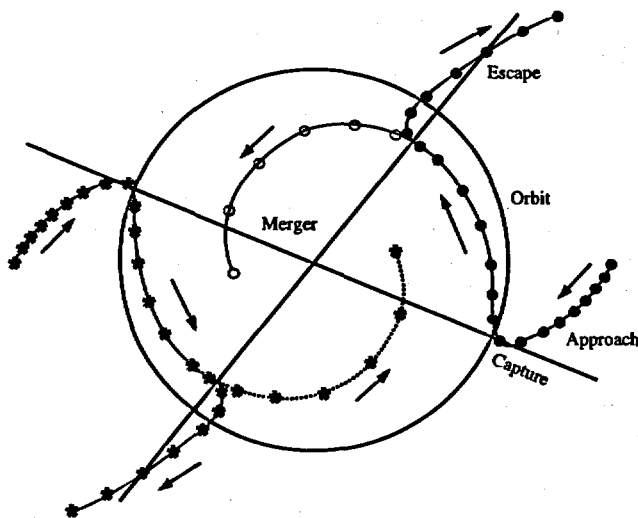


Figure A-1 Model of binary interaction of two tropical cyclones that contain the major elements of approach and capture, followed by mutual orbit, then escape, or merger.

CENTER - The vertical axis or core of a tropical cyclone. Usually determined by cloud vorticity patterns, wind and/or pressure distribution.

EPHEMERIS - Position of a body (satellite) in space as a function of time; used for gridding satellite imagery. Since ephemeris gridding is

based solely on the predicted position of the satellite, it is susceptible to errors from vehicle wobble, orbital eccentricity, the oblateness of the Earth, and variation in vehicle speed.

EXPLOSIVE DEEPENING - A decrease in the minimum sea-level pressure of a tropical cyclone of 2.5 mb/hr for at least 12 hours or 5 mb/hr for at least six hours (Dunnavan 1981).

EXTRATROPICAL - A term used to indicate that a cyclone has lost its "tropical" characteristics. The term implies both poleward displacement from the tropics and the conversion of the cyclone's primary energy source from the release of latent heat of condensation to baroclinic processes. In the XT technique (Miller and Lander 1997a) a tropical cyclone is defined as having completed extratropical transition when the circulation center has moved poleward of the polar jet maximum or when water vapor imagery clearly indicates the system has become entirely cold-core. It is important to note that cyclones can become extratropical and still maintain winds of typhoon or storm force.

EYE - The central area of a tropical cyclone when it is more than half surrounded by wall cloud.

INTENSITY - The maximum sustained 1-minute mean surface wind speed, typically within one degree of the center of a tropical cyclone.

MAXIMUM SUSTAINED WIND - The highest surface wind speed averaged over a 1-minute period of time. (Peak gusts over water average 20 to 25 percent higher than sustained winds).

MEI-YU FRONT - The Term "mei-yu" is the Chinese expression for "plum rains". The mei-yu front is a persistent east-west zone of disturbed weather during spring which is quasi-stationary and stretches from the east China coast, across Taiwan, and eastward into the Pacific south of Japan.

MONSOON DEPRESSION - A tropical cyclonic vortex characterized by: 1) its large size, the outer-most closed isobar may have a diameter on the order of 600 nm (1000 km); 2) a loosely organized cluster of deep convective elements; 3) a low-level wind distribution which features a 100-nm (200-km) diameter light-wind core which may be partially surrounded by a band of gales; and, 4) a lack of a distinct cloud system center. Note: most monsoon depressions which form in the western North Pacific eventually acquire persistent central convection and accelerated core winds marking its transition into a conventional tropical cyclone.

MONSOON GYRE - A mode of the summer monsoon circulation of the western North Pacific characterized by: 1) a very large nearly circular low-level cyclonic vortex that has an outer-most closed isobar with diameter on the order of 1350 nm (2500 km); 2) a cloud band rimming the southern through eastern periphery of the vortex/surface low; 3) a relatively long (two week) life span - initially, a subsident regime exists in its core and western and north-western quadrants with light winds and scattered low cumulus clouds; later, the area within the outer closed isobar may fill with deep convective cloud and become a monsoon depression or tropical cyclone; and, 4) the large vortex cannot be the result of the expanding wind field of a preexisting monsoon depression or tropical cyclone. Note: a series of small or very small tropical cyclones may emerge from the "head" or leading edge of the peripheral cloud band of a monsoon gyre (JTWC 1993; Lander 1994a).

RAPID DEEPENING - A decrease in the minimum sea-level pressure of a tropical cyclone of 1.75 mb/hr or 42 mb for 24-hours (Holliday and Thompson 1979).

RECURVATURE - The turning of a tropical cyclone from an initial path toward the west and poleward to east and poleward, after moving poleward of the mid-tropospheric subtropical ridge axis.

REVERSE-ORIENTED MONSOON TROUGH - The distinguishing characteristics of a reverse-oriented monsoon trough in the western North Pacific are a SW-NE (i.e., reverse) orientation of the trough axis with respect to the normal NW-SE orientation of the trough axis, and the penetration of the trough axis into subtropical areas normally the province of easterly flow.

SIGNIFICANT TROPICAL CYCLONE - A tropical cyclone becomes "significant" with the issuance of the first numbered warning by the responsible warning agency.

SIZE - The areal extent of a tropical cyclone, usually measured radially outward from the center to the outer-most closed isobar. Based on an average radius of the outer-most closed isobar, size categories in degrees of latitude follow: $< 2^\circ$ = very small, 2° to 3° = small, 3° to 6° = medium (average), 6° to 8° = large, and 8° or greater = very large (Brand 1972 and a modification of Merrill 1982).

STRENGTH - The average wind speed of the surrounding low-level wind flow, usually measured within a one to three degree annulus of the center of a tropical cyclone (Weatherford and Gray 1985).

SUBTROPICAL CYCLONE - A low pressure system that forms over the ocean in the subtropics and has some characteristics of a tropical circulation, but not a central dense overcast. Although of upper cold low or low-level baroclinic origins, the system can transition to a tropical cyclone.

SUPER TYPHOON - A typhoon with maximum sustained 1-minute mean surface winds of 130 kt (67 m/sec) or greater.

TROPICAL CYCLONE - A non-frontal, migratory low-pressure system, usually of synoptic scale, originating over tropical or subtropical waters and having a definite organized circulation.

TROPICAL DEPRESSION - A tropical cyclone with maximum sustained 1-minute mean surface winds of 33 kt (17 m/sec) or less.

TROPICAL DISTURBANCE - A discrete system of apparently organized convection, generally 100 to 300 nm (185 to 555 km) in diameter, originating in the tropics or subtropics, having a non-frontal, migratory character and having maintained its identity for 12- to 24-hours. The system may or may not be associated with a detectable perturbation of the low-level wind or pressure field. It is the basic generic designation which, in successive stages of development, may be classified as a tropical depression, tropical storm, typhoon or super typhoon.

TROPICAL STORM - A tropical cyclone with maximum 1-minute mean sustained surface winds in the range of 34 to 63 kt (18 to 32 m/sec), inclusive.

TROPICAL UPPER-TROPOSPHERIC TROUGH (TUTT) - A dominant climatological system and a daily upper-level synoptic feature of the summer season, over the tropical North Atlantic, North Pacific and South Pacific Oceans (Sadler 1979). Cold core lows in the TUTT are referred to as cells, or TUTT cells.

TYPHOON (HURRICANE) - A tropical cyclone with maximum sustained 1-minute mean surface winds of 64 to 129 kt (33 to 66 m/sec). West of 180° E longitude they are called typhoons and east of 180° E longitude hurricanes.

WALL CLOUD - An organized band of deep cumuliform clouds that immediately surrounds the central area of a tropical cyclone. The wall cloud may entirely enclose or partially surround the center.

WESTERLY WIND BURST - A short-duration low-level westerly wind event along and near the equator in the western Pacific Ocean (and sometimes in the Indian Ocean) (Luther et al. 1983). Typically, a westerly wind burst (WWB) lasts several days and has westerly winds of at least 10 kt (5 m/sec) (Keen 1988). Most WWBs occur during the monsoon transition months of April-May, and November-December. They show some relationship to the ENSO phenomenon (Luther et al. 1983; Ramage 1986). Some WWBs are even more energetic, with wind speeds of 30 kt (15 m/sec) observed during well-developed systems. These intense WWBs are associated with a large cluster of deep-convective cloud along the equator. An intense WWB is a necessary precursor to the formation of tropical cyclone twins symmetrical with respect to the equator (Keen 1982; Lander 1990).

APPENDIX B
NAMES FOR TROPICAL CYCLONES IN THE
WESTERN NORTH PACIFIC OCEAN AND SOUTH CHINA SEA

Column 1		Column 2		Column 3		Column 4	
ANN	AN	ABEL	<i>A-bel</i>	AMBER	<i>AM-ber</i>	ALEX	<i>AL-x</i>
BART	<i>BART</i>	BETH	<i>BETH</i>	BING	<i>BING</i>	BABS	<i>BABS</i>
CAM	<i>KAM</i>	CARLO	<i>KAR-lo</i>	CASS	<i>KASS</i>	CHIP	<i>CHIP</i>
DAN	<i>DAN</i>	DALE	<i>DAY-l</i>	DAVID	<i>DAY-vid</i>	DAWN	<i>DAWN</i>
EVE	<i>EEV</i>	ERNIE	<i>ER-nee</i>	ELLA	<i>EL-la</i>	ELVIS	<i>EL-vis</i>
FRANKIE	<i>FRANK-ee</i>	FERN	<i>FERN</i>	FRITZ	<i>FRITZ</i>	FAITH	<i>FAITH</i>
GLORIA	<i>GLOR-ee-uh</i>	GREG	<i>GREG</i>	GINGER	<i>JIN-ger</i>	GIL	<i>GIL</i>
HERB	<i>HERB</i>	HANNAH	<i>HAN-nah</i>	HANK	<i>HANGK</i>	HILDA	<i>HIL-dah</i>
IAN	<i>EE-an</i>	ISA	<i>EE-sah</i>	IVAN	<i>I-van</i>	IRIS	<i>I-ris</i>
JOY	<i>JOY</i>	JIMMY	<i>JIM-ee</i>	JOAN	<i>JONE</i>	JACOB	<i>JAY-kob</i>
KIRK	<i>KIRK</i>	KELLY	<i>KEL-lee</i>	KEITH	<i>KEETH</i>	KATE	<i>KATE</i>
LISA	<i>LEE-sah</i>	LEVI	<i>LEEV-eye</i>	LINDA	<i>LIN-dah</i>	LEO	<i>LEE-o</i>
MARTY	<i>MAR-tee</i>	MARIE	<i>mah-REE</i>	MORT	<i>MORT</i>	MAGGIE	<i>MAG-gee</i>
NIKI	<i>NI-kee</i>	NESTOR	<i>NES-tor</i>	NICHOLE	<i>nik-KOL</i>	NEIL	<i>NEEL</i>
ORSON	<i>OR-son</i>	OPAL	<i>O-pel</i>	OTTO	<i>OT-tow</i>	OLGA	<i>OL-gah</i>
PIPER	<i>PI-per</i>	PETER	<i>PEE-ter</i>	PENNY	<i>PEN-nee</i>	PAUL	<i>PAUL</i>
RICK	<i>RICK</i>	ROSIE	<i>RO-zee</i>	REX	<i>REX</i>	RACHEL	<i>RAY-chel</i>
SALLY	<i>SAL-lee</i>	SCOTT	<i>SKOT</i>	STELLA	<i>STEL-lah</i>	SAM	<i>SAM</i>
TOM	<i>TOM</i>	TINA	<i>TEE-nah</i>	TODD	<i>TOD</i>	TANYA	<i>TAHN-yah</i>
VIOLET	<i>VI-uh-let</i>	VICTOR	<i>vik-TOR</i>	VICKI	<i>VIK-kee</i>	VIRGIL	<i>VER-jil</i>
WILLIE	<i>WIL-lee</i>	WINNIE	<i>WIN-nee</i>	WALDO	<i>WAL-do</i>	WENDY	<i>WEN-dee</i>
YATES	<i>YATES</i>	YULE	<i>YOU-I</i>	YANNI	<i>YAN-ni</i>	YORK	<i>YORK</i>
ZANE	<i>ZANE</i>	ZITA	<i>ZEE-tah</i>	ZEB	<i>ZEB</i>	ZIA	<i>ZEE-uh</i>

NOTE 1: Assign names in rotation, alphabetically, starting with (ANN) for first tropical cyclone of 1996. When the last name in Column 4 (ZIA) has been used, the sequence will begin again with the first name in Column 1 (ANN).

NOTE 2: Pronunciation guide for names is italicized.

SOURCE: CINCPACINST 3140.1W

APPENDIX C CONTRACTIONS

AB	Air Base	ARQ	Automated Response to Query	COMNAVMETOPCOM or CNMOC	Commander Naval Meteorology and Oceanography Command
ABW	Air Base Wing	ATCF	Automated Tropical Cyclone Forecast (system)	CPA	Closest Point of Approach
ABIO	Significant Tropical Weather Advisory for the Indian Ocean	ATCR	Annual Tropical Cyclone Report	CPHC	Central Pacific Hurricane Center
ABPW	Significant Tropical Weather Advisory for the Western Pacific Ocean	AUTODIN	Automated Digital Network	CSC	Cloud System Center
ACCS	Air Control Center Squadron	AVHRR	Advanced Very High Resolution Radiometer	CSUM	Colorado State University Model
ACFT	Aircraft	AWDS	Automated Weather Distribution System	CW	Continuous Wave
ADEOS	Japanese Advanced Earth Observing Satellite	AWN	Automated Weather Network	DAVE	Dynamic Average
ADP	Automated Data Processing	BLND	Blended (Hybrid Aid)	DD	Digital Dvorak
AFB	Air Force Base	BRAC	Base Realignment and Closure	DDN	Defense Data Network
AFDIS	Air Force Dial-In System	CDO	Central Dense Overcast	DEG	Degree(s)
AFGWC	Air Force Global Weather Central	CI	Current Intensity	DFS	Digital Facsimile System
AIREP	Aircraft (Weather) Report	CIMSS	Cooperative Institute for Meteorological Satellite Studies	DISN	Defense Information Systems Network
AJTWC	Alternate Joint Typhoon Warning Center	CIV	Civilian	DMS	Defense Messaging System
AMOS	Automated Meteorological Observing Station	CLD	Cloud	DMSP	Defense Meteorological Satellite Program
AOR	Area of Responsibility	CLIM	Climatology	DOD	Department of Defense
ARC	Automated Remote Collection (system)	CLIP or CLIPER	Climatology and Persistence Technique	DSN	Defense Switched Network
ARGOS	(International Service for Drifting Buoys)	CM	Centimeter(s)	DTG	Date Time Group
		C-MAN	Coastal-Marine Automated Network	EGRR	Bracknell Model
		CMOD	Compact Meteorological and Oceanographic Drifter (buoy)	ENSO	El Niño-Southern Oscillation

ERS	European Remote Sensing Satellite	ICAO	International Civil Aviation Organization	MET	Meteorological
FBAM	FNMOC Beta and Advection Model	INIT	Initial	METEOSAT	European Meteorological Satellite
FI	Forecast Intensity (Dvorak)	INST	Instruction	MIDDAS	Meteorological Imagery, Data Display, and Analysis System
FLENUMMETOCEN or FNMOC	Fleet Numerical Meteorology and Oceanography Center	IP	Internet Protocol	MIN	Minimum
FT	Foot/Feet	IR	Infrared	MINI-MET	Mini-Meteorological (buoy)
FTP	File Transfer Protocol	JGSM	Japanese Global Spectra model	MISTIC	Mission Sensor Tactical Imaging Computer
GCA	Great Circle Arc	JTWC	Joint Typhoon Warning Center	MM	Millimeter(s)
GFDN	Geophysical Fluid Dynamics - Navy	JTWC92 or JT92	Statistical-Dynamical Objective Technique	MOVG	Moving
GMS	Japan Geostationary Meteorological Satellite	JTYM	Japanese Typhoon Model	MSLP	Minimum Sea-level Pressure
GMT	Greenwich Mean Time	KM	Kilometer(s)	MSU	Microwave Sounding Unit
GOES	Geostationary Operational Environmental Satellite	KT	Knot(s)	NARDAC	Naval Regional Data Automation Center
GSRS	Geostationary Satellite Receiving System	LAN	Local Area Network	NAS	Naval Air Station
GTS	Global Telecommunications System	LAT	Latitude	NASA	National Aeronautics and Space Administration
HIRS	High Resolution Infrared Sounder	LLCC	Low-Level Circulation Center	NAVPACMETOCEN or NPMOC	Naval Pacific Meteorology and Oceanography Center (Hawaii)
hPa	Hectopascal	LONG	Longitude	NAVPACMETOCEN WEST or NPMOCW	Naval Pacific Meteorology and Oceanography Center West (Guam)
HPAC	Mean of XTRP and CLIM Techniques (Half Persistence and Climatology)	LUT	Local User Terminal	NCEP	National Centers for Environmental Prediction
HF	High Frequency	LVL	Level	NEDN	Naval Environmental Data Network
HR	Hour(s)	M	Meter(s)		
HRPT	High Resolution Picture Transmission	MAX	Maximum		
		MB	Millibar(s)		
		MBAM	Medium Beta and Advection Model		
		MCAS	Marine Corps Air Station		
		MCS	Mesoscale Convective System		

NESDIS	National Environmental Satellite, Data, and Information Service	NRL-MRY	Naval Research Laboratory at Monterey, CA	PIREP	Pilot Weather Report(s)
NESN	Naval Environmental Satellite Network	NSCAT	NASA Scatterometer	QBO	Quasi-Biennial Oscillation
NEXRAD	Next Generation (Doppler Weather) Radar (WSR-88D)	NSDS-G	Naval Satellite Display System - Geostationary	RADOB	Radar Observation
NGDC	National Geophysical Data Center	NTWP	Naval Telecommunications Area Master Station, Western Pacific	RECON	Reconnaissance
NHC	National Hurricane Center	SIPRNET	Secret Internet Protocol Router Network	RECR	Recurve (Forecast Aid)
NIPRNET	Non-secure Internet Protocol Router Network	NWP	Northwest Pacific	RMSE	Root mean square error
NM	Nautical Mile(s)	NWS	National Weather Service	ROCI	Radius of outer-most closed isobar
NMC	National Meteorological Center (now NCEP)	OBS	Observations	SAT	Satellite
NOAA	National Oceanic and Atmospheric Administration	OLS	Operational Linescan System	SCS	South China Sea
NODDES	Naval Oceanographic Data Distribution and Expansion System	ONR	Office of Naval Research	SDHS	Satellite Data Handling System
NODDS	Naval Oceanography Data Distribution System	OSS	Operations Support Squadron	SEC	Second(s)
NOGAPS or NGPS	Navy Operational Global Atmospheric Prediction System	OSB	Ocean Sciences Branch	SFC	Surface
NORAPS or NRPS	Navy Operational Regional Atmospheric Prediction System	OTCM	One-Way (Interactive) Tropical Cyclone Model	SGDB	Satellite Global Data Base
NPS	Naval Postgraduate School	PACAF	Pacific Air Force	SIPRNET	Secret Internet Protocol Router Network
NR	Number	PACMEDS	Pacific Meteorological Data System	SLP	Sea-Level Pressure
NRL	Naval Research Laboratory	PACOM	Pacific Command	SPAWARSSYSCOM	Space and Naval Warfare Systems Command
		PAGASA	Philippine Atmospheric, Geophysical, and Astronomical Services Administration	SPIDR	Space Physics Interactive Data Resource
		PC	Personal Computer	SSM/I	Special Sensor Microwave/Imager
		PCN	Position Code Number	SST	Sea Surface Temperature
		PDN	Public Data Network	SSU	Stratosphere Sounding Unit
				ST	Subtropical
				STNRY	Stationary

STR	Subtropical Ridge	TOGA	Tropical Ocean Global Atmosphere	WESTPAC or WNP	Western (North) Pacific
STRT	Straight (Forecast Aid)	TOVS	TIROS Operational Vertical Sounder	WGTD	Weighted (Hybrid Aid)
STY	Super Typhoon	TS	Tropical Storm	WMO	World Meteorological Organization
SWDIS	Satellite Weather Data Imaging System	TUTT	Tropical Upper-Tropospheric Trough	WRN or WRNG	Warning(s)
TAPT	Typhoon Acceleration Prediction Technique	TY	Typhoon	WSD	Wind Speed and Direction
TC	Tropical Cyclone	TYAN	Typhoon Analog (Forecast Aid)	WSR-88D	Weather Surveillance Radar - 1988 Doppler
TCFA	Tropical Cyclone Formation Alert	ULCC	Upper-Level Circulation Center	WVTW	Water Vapor Tracked Winds
TD	Tropical Depression	US	United States	WWB	Westerly Wind Burst
TDA	Typhoon Duty Assistant	USAF	United States Air Force	WWW	World Wide Web
TDO	Typhoon Duty Officer	USCINCPAC	Commander-in-Chief Pacific (AF - Air Force, FLT - Fleet)	XT	Extratropical
TELEFAX	Telephone Facsimile	USN	United States Navy	XTRP	Extrapolation
TESS	Tactical Environmental Support System	VIS	Visual	Z	Zulu time (Greenwich Mean Time/Universal Coordinated Time)
TIFF	Tagged Image File Format	WAN	Wide Area Network		
TIROS-N	Television Infrared Observational Satellite-Next Generation				

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1961	AD 786149	1974	AD 010271	1986	AD A184082
1962	AD 786128	1975	AD A023601	1987	AD A191883
1963	AD 786208	1976	AD A038484	1988	AD A207206
1964	AD 786209	1977	AD A055512	1989	AD A232469
1965	AD 786210	1978	AD A070904	1990	AD A239910
1966	AD 785891	1979	AD A082071	1991	AD A251952
1967	AD 785344	1980	AD A094668	1992	AD A274464
1968	AD 785251	1981	AD A112002	1993	AD A285097
1969	AD 785178	1982	AD A124860	1994	AD A301618
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<p>ANNUAL PUBLICATION SUMMARIZING TROPICAL CYCLONE ACTIVITY IN THE WESTERN NORTH PACIFIC, BAY OF BENGAL, ARABIAN SEA, WESTERN SOUTH PACIFIC AND SOUTH INDIAN OCEANS. A BEST TRACK IS PROVIDED FOR EACH SIGNIFICANT TROPICAL CYCLONE. A BRIEF NARRATIVE IS GIVEN FOR ALL TROPICAL CYCLONES IN THE WESTERN NORTH PACIFIC AND NORTH INDIAN OCEANS. ALL FIX DATA USED TO CONSTRUCT THE BEST TRACKS ARE PROVIDED UPON REQUEST ON DISKETTES. FORECAST VERIFICATION DATA AND STATISTICS FOR THE JOINT TYPHOON WARNING CENTER (JTWC) ARE SUBMITTED.</p>					
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BACK COVER: From its location on Guam, JTWC monitors an area of responsibility that stretches from 180° east longitude westward across the Western Pacific and Indian Oceans to the eastern coast of Africa.

1996 Tropical Cyclone Tracks

